OCT 1 1943

Gas Journal

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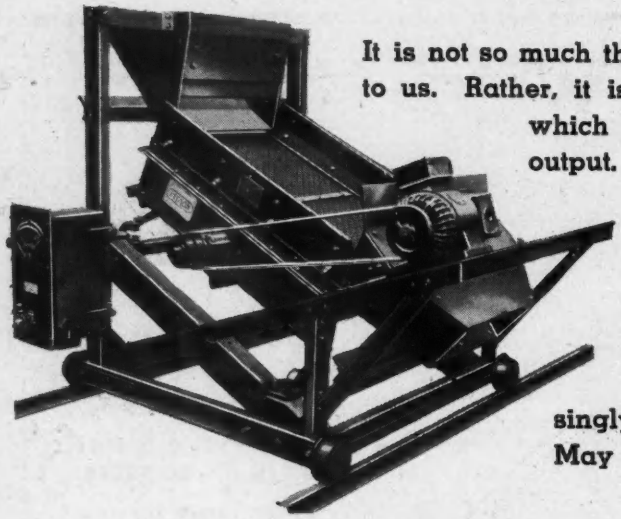

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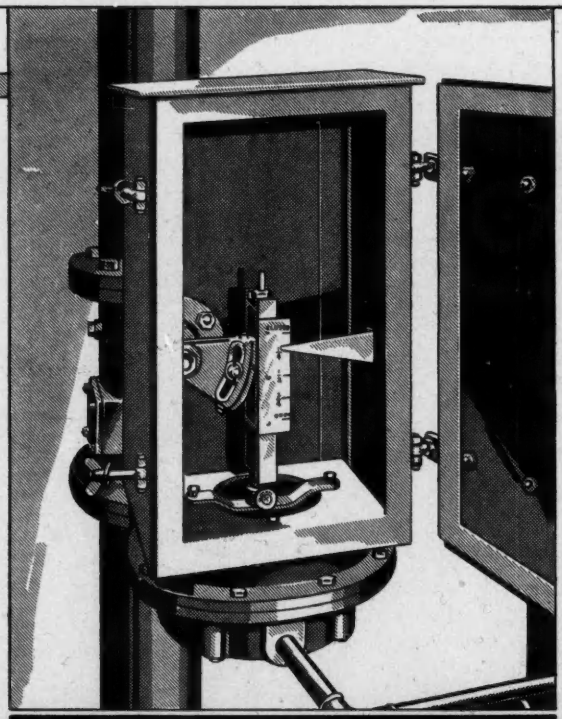

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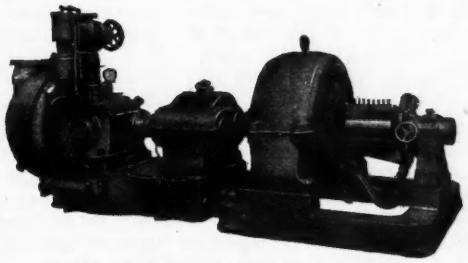

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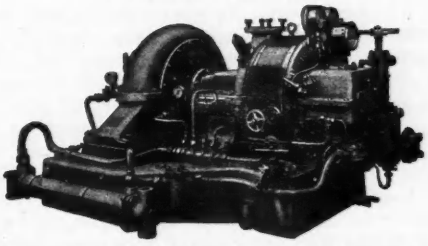

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GAS JOURNAL, SEPT. 1, 1943

VOL. 242 95th YEAR No. 4189

EDITORIAL NOTES

TALK AND ACTION

DISCUSSION on the future of the Gas Industry continues; councils and committees are meeting and recommending, and inevitably and according to rule a great many of the suggestions made cancel one another out. The path towards agreement within the Industry has yet to be discovered. In the present jungle of confused thought we obviously need more leadership and less obstruction, and while the committee system may in theory be democratic, it is all too often in practice clumsy and very slow-acting. We are well informed by our local correspondents of the discussions which are taking place. From our mail this week, for instance, we learn that the St. Ives Town Council are urging the Horncastle Rural District Council to agree with them that the Gas Industry should be State owned and State controlled. The Reverend W. D. Chapman, of Horncastle, is all for it, but unseduced by his support and advocacy the Council of St. Ives' resolution has been allowed to lie on the table. At Clitheroe a resolution was carried that in the interests of public and consumers the Industry should be publicly owned and reorganized "to obtain as great a measure of intimate local control as possible." The Sittingbourne and Milton Urban Council have approved the following resolution: "That the Council submit to the next meeting of the British Gas Federation that they are of opinion that the Industry should be placed under public control and ownership as now applies for the administration of essential public services, that there should be co-ordination of activities with such neighbouring authorities as may be found necessary or desirable, and that particulars of the uneconomical effects experienced in the Council's district by control of the gas undertaking by other than public interest be communicated to the Gas Federation." The Sittingbourne district is supplied with gas by two undertakings, one controlled by the South-Eastern Gas Corporation, the other by the Sittingbourne and Milton U.D.C. Is the aim of the Sittingbourne Council to absorb the South-Eastern Gas Corporation? So we could go on, but obviously even from these few references there is not a vast measure of unity in the Industry. Talk proceeds apace, about it and about; and some of it would appear to be a trifle jumbled.

The while, of course, so much remains to be done, and we would add that nationalization or private or public ownership does not make gas and coke. The responsibility for this rests with the man on the job. Practical gas making is not Whitehall's job; nor is that of the local butcher or the local clergyman; and the gas consumer, the ordinary housewife, is not in the very least interested. Progress in the Industry must come from within, and progress cannot be made unless the men within are enthusiastic, knowledgeable—*and practical*. The Industry must attract such men by offering good money and *it must work for enhanced prestige value*. Solutions to many of the technical problems before the Gas Industry have been set out. There is scope in plenty for increased efficiency. In the first place improvement devolves on the men who plan, build, and operate the works, whether they be gas-works or coke ovens; secondly, there are the men who design and operate the distribution systems; thirdly, there is the aspect of consumer service, and this is a science in itself. Starting on the basis that the future of the Gas Industry will depend on how it can meet consumers' requirements, there must, of course, be an overriding and agreed policy on what the Industry is really setting out to be—either a gas, a purely gas industry or a two-fuel industry supplying gas and smokeless fuel. Our own views on this we have stated many times, and we still hold the belief that if the Industry chooses to become "all-gas" it will find itself a very small industry. The Industry does not, however, appear to have made up its mind about this. More's the pity.

As we have said, the solutions to many problems confronting the Gas Industry have been pointed out. There will, for instance, be opportunity for alteration in plant lay-out after the war, on the lines suggested notably, and so clearly, by Dr. Pexton in the "JOURNAL" in the early part of this year; there will be opportunity for the extension of coke-oven gas supply; there will be opportunity for carrying into effect the recommendations of the four I.G.E. Committees of Enquiry. There will be other opportunities of a thoroughly practical nature, the grasping of which is in the hands of the gas engineer, not in the hands of the civil servant or the local baker, certainly not in the hands of committees, however democratic and however learned. Not a magic wand will cement the Industry's future prosperity, but hard work coupled with horse sense, though, for the time being, they also serve who only plan and plan.

THE KEY TO THE FUTURE

SIGNS are not wanting—the debate in the House of Lords to which we called attention in the "JOURNAL" last week is a case in point—that we are approaching a time when the scientist and the technically trained man will come more fittingly into his own. Circumstances will, we feel sure, make this inevitable in the national interest; hence our own interest in an important and comprehensive pamphlet issued on Saturday last by the Federation of British Industries and written by that eminent and experienced authority Sir Harold Hartley. The title is "Industrial Research: What it Means to Industry"; and in a foreword it is explained that the pamphlet is written in the confident belief that industrial research is going to be the vital factor in determining the future prosperity of Great Britain. "Whatever else we do, whatever advantages we possess, research is the key to the future." The prosperity of Britain after the war will depend more than ever before on the efficiency and progressiveness of our industries; the easy inventions and obvious developments have already been made, and Nature now only yields her further secrets as a result of much more prolonged and careful searching. Haphazard enquiry must be replaced by organized and systematic study. "In the future the advantages Britain possesses in the skill and traditions of her craftsmen will depend more and more on the science that directs their efforts. Labour and research must work hand in hand."

Sir Harold Hartley in this very straightforward document makes it plain that, despite some outstanding exceptions in this country, there has not been a general appreciation of the value of science in industry, and we have not spent enough money on it. For example, we spent pre-war nothing like enough in comparison with the United States of America. It is a question not of any lower standing of British science, but of opportunity. There are plenty of examples to illustrate the unexpected practical significance of the by-products of pure scientific research; and Sir Harold emphasizes that it is in the university laboratories, the outposts on the frontiers of knowledge, that fundamental research is mainly done. At any time a new industry may be born there which will meet some new human need. It is in the atmosphere of the university laboratory, too, that the men on whom we shall have to rely as leaders of industrial research are bred and trained. Business therefore has a direct interest in seeing that research at universities and in technical colleges is adequately endowed. There are also the Research Stations of the D.S.I.R. and the Research Associations, which have steadily expanded in size and usefulness, but are not yet on a scale commensurate with the industries they serve; only

four of them have an expenditure exceeding £50,000 per annum, which represents 0.06% of the turnover of the industries concerned. Finally, there are the private industrial research laboratories, and hardly any of the firms which possess research laboratories confine their expenditure on research to their own establishments. They are, as a rule, the strongest supporters of the Research Associations, and make the most use of the results obtained in the D.S.I.R. stations and at university laboratories. They realize that research is a sound investment. Whatever the scale on which research is begun, it is a general experience that its budget increases as it is found to be more and more indispensable. No industry can afford to neglect research; it is the only safeguard of the future. And the main appeal of Sir Harold Hartley's memorandum, which states the case in terms calculated to appeal to practical industrialists and men of affairs, is that the help which science can give to contemporary industry shall be accepted and that more industrialists shall become "research-minded."

Plan for Clean Air

Under this title the National Smoke Abatement Society has published an outline of the case for smoke prevention in the popular form of a "quiz" of twenty questions and answers. Starting with the questioner asking "Is a plan really necessary?" and "How important is the problem?" the pamphlet describes the basis of smoke prevention to-day, and point by point shows the steps to be taken—starting with the prevention of smoke from all the new buildings and houses to be built after the war. If all post-war building is smokeless, the task will then resolve itself into the progressive elimination of smoke from existing sources.

This the Society proposes should be done by first of all setting up "smokeless zones" for the central or other suitable areas of our towns, and then, when conditions make a start opportune, gradually extending these initial zones until, after a given period—ten years is considered appropriate—the whole town is freed from smoke. "A plan for smoke prevention," says the answer to one question, "dovetails into the fuel policy required by the nation, and is a link between the three major national problems of fuel, health, and town-planning." Those concerned with planning are reminded that "The ceaseless fall of smoke-dirt degrades environment, robs our towns of much of the amenity they might enjoy, and is one of the principal causes of urban squalor. Reconstruction and town-planning measures that fail to take this factor into account can never fully achieve their goal."

The Coal Research Club

The hundredth meeting of the Coal Research Club has been held, and the completion of a "century" is a suitable opportunity for note and congratulation. We may recall that the formation of the Club was the upshot of an after-dinner chat between Dr. Lessing and the late Professor Wheeler. It was then, at the beginning of 1921, that the issue of a journal—now *Fuel in Science and Practice*—was decided upon. The club, as eventually constituted, was to comprise only those who had done, and were actively engaged in, true research into the constitution or utilization of coal. A limitation of the scope of the club's work was determined by the belief that the first requirement for a solution of the "coal problem" was an intensive examination of the raw material itself, inasmuch as, without a considerable addition to existing knowledge in this respect, the task of the mining engineer, the gas and coke maker, and the fuel technologist in general was rendered unnecessarily difficult. The limitation of the scope of the Coal Research Club is reflected by the small number of its members, who bind themselves not to make use of their membership for any commercial purpose whatsoever. This is necessitated by another rule, which forms the *raison d'etre* of the organization—namely, that members undertake to render mutual assistance to the best of their ability by information, criticism, and suggestion, and to submit to the club the results of their work in advance of publication. Apart from an honorary secretary, there are no officers, and there is no president or chairman. Close relations existed for years between some of the members of the Coal Research Club and the most prominent coal investigators in the United States of America, and this led to the formation of an American branch of the Club. Dr. A. C. Fieldner, Chief of the Fuels and Explosives Service of the United States Bureau of Mines, has been acting throughout as honorary secretary of this branch, and the collaboration has resulted in a healthy interchange of ideas. The Club goes ahead maintaining its activities and usefulness.

§§

Personal

Mr. G. J. B. Cox, B.E.M., B.Sc., Assistant Engineer on the Staff of the Gas Light and Coke Company, has been appointed Assistant Engineer to the Tunbridge Wells Gas Company. Mr. Cox took his degree in mechanical engineering at Durham University, and served for his first few years in the Gas Industry in the Newcastle and Gateshead Gas Company and the Sunderland Gas Company (his father was Secretary and Director of the Sunderland Gas Company until his death in 1935). In 1936 he joined the staff of the Gas Light and Coke Company, where he worked at the Beckton and Stratford Stations. While at Stratford in 1941 he was awarded the B.E.M. for his service during the periods of heavy raids on London.

* * *

Mr. PERCY D. WADSWORTH, LL.B., the new Town Clerk of Accrington, will also be Clerk to Accrington District Gas and Water Board in succession to Mr. W. H. Warhurst.

* * *

Mr. ALEX. O. RUSSELL, Director of the Company, has been appointed Sales Director of Messrs. Fletcher, Russell & Co., Ltd. He will take up his duties as from Oct. 1.

Obituary

The death has occurred of Alderman JOHN BARLOW, at the age of 89. He had a very long record of public service and was Chairman of the Accrington District Gas and Water Board for 15 years.

Letters to the Editor

"Municipalization"

DEAR SIR,—It appears that complete suppression through the Press of the present great issues before the Industry is, in view of recent developments, extremely unwise.

Those who oppose the formation of one authoritative Gas Association do so in order to superimpose on the Gas Industry side issues not truly representing the desires of a substantial majority. The one solid aim of the proposed British Gas Association is to develop the Industry on democratic lines, and give the *gas consumer* a better and more nationally equal fuel service.

The issue of ownership is admittedly most complex; the suggestions before the Industry in this matter are clear, and run counter to the highest ideals any industry could wish to achieve.

The Association of Municipal Corporations now comes along with the bogy, "Any reorganization of public utilities should be deferred until reorganization of local government has been considered." The basis of this suggestion is the setting up of all-purpose local authorities, including public utilities, within stated areas. To expect the Gas Industry to await settlement of local government reorganization is suggestive of dropping all our plans and benignly submitting to watching the wrangling and time-honoured methods of local authorities' litigation, the while other fuel industries progress. The Association of Municipal Corporations' suggestions are a menace to all small local authorities, all company-owned undertakings, and if adopted would serve only as aggrandisement to the selected local authorities; they would definitely be a deterrent to Gas Industry advance, and the gas consumer would be sacrificed to the interest of the general public. Municipalization—what a word!—would be the death of the Gas Industry; better nationalization; far better, let the Industry develop along its own lines, free from local prejudice and politics, free to serve the nation, not the grabbers for power and would-be spoilers of our country.

Yours faithfully,

Aug. 25, 1943. "UPHOLDER."

Research and Expenditure

DEAR SIR,—We can rarely take up a technical journal these days without being faced with leaders, letters, and articles on Research, and Coal Research in particular. More often than not, the writers bring up comparisons of the relative sums spent on research in Great Britain, Germany, and America, and one is almost led to believe that the amount of money spent on research is really the most important aspect of the question.

Although these discussions are now being intensified, the subject being "fashionable" for the moment, we heard the same sort of argument years ago. We recall listening to a very spirited Address on this subject about 14 years since, at a joint meeting of a few Institutions in London. The principal speaker devoted much of his time to attacking the mine owners for their lack of appreciation of research, yet it was obvious to some of us that he was blissfully unaware of the Research Associations which had been sponsored, financed, and supported by the coal owners since 1910, and even much earlier than that. He had not heard of the Doncaster Coal Owners' Research Association, the Lancashire and Cheshire Coal Owners' Research Association, nor was he aware of the research activities of such concerns as the Powell-Duffryn Colliery Company. He almost overlooked the fact that at that time the F.R.B. were spending about £100,000 per annum on coal research. Since those days the same dish has been repeatedly re-hashed over and over again.

In my view we are harping on the wrong string. *The important question is not how much we are spending, but whether we are spending wisely.* Are we getting good value for what is being spent? If so, let us hear about it. If not, then we should apply the soft pedal on "expenditure." In this connexion it would prove very interesting and probably illuminating, if some energetic individual would make an accurate survey of organized research on coal which has been carried out during the past 25 years, showing clearly how much (or how little) has been accomplished, in order that we may judge whether the expenditure has been justified. This survey should not be confined to the activities of the Fuel Research Board. If it can be shown that the funds have been profitably expended, we would then feel encouraged to invite the investigators concerned to undertake other and bigger jobs, and place more finance at their disposal. Side by side with this balance-sheet the assessor could record what has been accomplished, and at what cost, by investigators who were unattached to organized research bodies—the free lances.

One hears far too much talk about long-range research, and too little about short-range research. The publication of some of the long-range researches we have in mind was so long delayed that the valuable information which they contained could not be applied when it appeared in print. Further, a good deal of what goes under the name of research is merely routine investigation. This remark applies to coal investigations carried out in this country, the U.S.A., Germany, Japan, and South Africa. A few examples will suffice. We read in a journal published in May, 1943, that recent researches carried out in the U.S.A. show that: "Blending 20 to 30% of low-volatile coals with high-volatile coals yields cokes of improved but varying properties." Now, not only will this information be found in a 13-year-old textbook, but the art has been practised in S. Wales for at least 40 years. We read further that: "Generally, oxidation reduces progressively the plasticity and fluidity of a coal during carbonization . . . low-volatile coals lose their coking tendency more quickly than medium-volatile coals, but coals of high original oxygen content lose their coking qualities quickly, regardless of their volatile matter content." This again is what students of fuel technology of the present generation learnt in their first year.

More recently still we read that a German researcher has found that certain Silesian coals can be made to yield improved cokes when blended with semi-coke containing 15 to 17% of volatile matter. This fact was determined by Bönnemann and recorded in *Glückauf* as long ago as Nov. 11, 1926.

Many years since, R. Ray demonstrated that he could obtain a superior coke by blending anthracite and coking coal. This "discovery" has recently been recorded by researchers in the U.S.A.

In this year of grace also we "learn" from another country the changes which take place when coal is heated at various stages up to 500°C.—more elementary information put forward as research.

Examples such as these could be multiplied, and we can well imagine that it is small consolation to those who provide the funds to be told that more shekels remain in the Treasury store. It is time a distinction was drawn between original research and routine investigations, and that those who finance research should see that value is received for the outlay expended. Those who pay the piper are entitled to ask for, and receive, results, and research workers must realize that lying behind the conception of research is *Service*—service to their employers, the community, the State, and the whole world. It would appear from what has been said and written in certain quarters that the first essential is to find a thousand or more jobs at a thousand pounds per annum each. I would not subscribe to that view. The keynote should be Service—not jobs. What steps are being taken to see that the necessary service will be rendered?

Yours faithfully,
"OLD TIMER."

Aug. 27, 1943.

Supply of Wrapped Pipes

In view of the need to conserve bitumen, it has been decided by the Ministry of Fuel and Power and the Director for Tubes, Pipes, and Fittings, that as soon as stocks in manufacturers' hands are exhausted, the use of bitumen for coating iron and steel pipes shall cease. The materials affected and the alternatives to be adopted include:

Item.	Material.	Treatment.	Prohibited.	"Economy specification."
Gas mains	Cast iron or steel	Dipped or externally coated	Bitumen, Dr. Angus Smith's solution (original formula)	Coal tar base solution (often called Dr. Angus Smith's solution) (see Note 1)
Gas and Water Service pipes	—	Internal spun linings	Bitumen	As above (see Note 2)
		Heavy external protection, felt or fabric reinforced	" Asbestos Jute	As above (see Note 2)

Note 1.—Coatings on mains must conform with the requirements of B.S.S. No. 78/1938, "Cast Iron Pipes, for Water, Gas, and Sewage," Clause 26.

Note 2.—Bitumen may continue to be used for the dipping or external coating of steel tubes until manufacturers' stocks are exhausted.

From now onwards, however, no further wrapping (whether using bitumen or coal tar base solution), nor sheathing nor lining may be applied to steel tubes except for steel tubes exposed to exceptionally aggressive conditions and with the permission of the Ministry of Fuel and Power, Gas and Electricity Division, New Oxford House, Bloomsbury Way, W.C. 1.

This permission must be obtained by the user of the steel tubes required and must be passed on to the manufacturers with the order.

New Specification for Ladders

The British Standards Institution has recently issued a War Emergency British Standard Specification No. 1129 for Ladders. The preparation of this specification was authorized in response to a request received from the Timber Control, in order to effect economy so far as is compatible with safety in the use of timber for these ladders.

The specification has been limited to extension and step ladders.

It covers the species of timber that may be used, it limits the defects permissible in the timber, such as knots, surface checks, inclination of grain, and the moisture content, &c., and it then goes on to specify the dimensions and gives certain details in regard to the method of construction.

Copies may be obtained from the British Standards Institution, 28, Victoria Street, S.W. 1, at a cost of 2s. each, post free.

Diary

Sept. 14.—Federation of Gas Employers: Centra Committee, Gas Industry House, 12 noon.

Sept. 14.—National Gas Council: Central Executive Board, Gas Industry House, 2.15 p.m.

Sept. 16.—Association of Gas Corporations: Council, 3.30 p.m., Gas Industry House.

Sept. 20.—London and Counties Coke Association: Finance Committee, 10.30 a.m.; Executive Committee, 11 a.m.; Central Committee, 12 noon; Annual Luncheon, 1 p.m.; Annual Meeting, 2.45 p.m., at the Waldorf Hotel, Aldwych, W.C. 2.

Oct. 11.—National Federation of Gas Coke Associations: General Committee (Special Meeting), 2.30 p.m., Gas Industry House.

Oct. 12.—National Federation of Gas Coke Associations: General Committee, 10 a.m., Gas Industry House.

1943 "Journal" Directory

Page 80. ABERFELDY. W. W. Walker, *S.*, *vice* J. Ferguson, deceased.

On Aug. 21 the Tunbridge Wells Gas Company completed a hundred years of public service.

At the General Meeting of the Wisbech Lighting Company the following dividends were passed: 12% on the original £3 stock and 11% on the ordinary £5 shares.

The Plymouth & Stonehouse Gas Light and Coke Company has decided to pay interest on Debenture Stock for the half-year to Sept. 3 next at the rate of 3% per annum on the 3% Debenture Stock, 3½% on the 3½% Debenture Stock, 4% on the 4% Debenture Stock, 5% on the 5% Debenture Stock—all less income tax at 10s. in the £. For transferees to receive this interest, transfers must be lodged with the Company by 5.30 p.m. on Sept. 13 next.

Duns Gas Company, Ltd., Berwickshire, has been formed into a new company with capital of £15,000 in £1 shares, of which 5,000 are preference shares and 10,000 ordinary shares. The company has been formed to carry into effect an agreement of sale with the former company. Its Directors are the Rev. Dr. J. Cairns, Messrs. Thomas Anderson, William Laidlaw, C. McLaren, R. J. Philp, and D. A. Veitch.

Interest in the construction and working of Nursery Centres for children is steadily growing, and the fitting of these with gas equipment for the essentials of heating, cooking, and for hot-water supply has proved very satisfactory. It is now beyond all question that these children's centres are doing very valuable work for the national well-being, and that they will rapidly increase in numbers when conditions become normal again and more materials are available. From the goodwill point of view, every one of these Centres is a focal point of publicity for the Gas Industry. The issue of *Illustrated* of Aug. 14 devotes a leading section to one of these centres, including a whole page in colour, which is an index of the importance that is being attached to the subject by the authorities and the general public. This particular Nursery fitted with gas cooking, heating, and hot-water apparatus by Radiation Ltd., is one of a large number of such Centres equipped for the Hertfordshire County Council, and is considered as a model of its kind.

DESIGN AND OPERATION OF A GAS LIQUOR CONCENTRATION PLANT*

By S. C. BENTLEY, Oxford and District Gas Company

A GREAT deal of research has been conducted in recent years on the disposal of ammoniacal liquor by the Liquor Effluents and Ammonia Committee of The Institution of Gas Engineers, and full accounts of this work given in the reports of this Committee, while a comprehensive survey of the whole question of liquor disposal is given in Dr. Arthur Key's book, *Gas Works Effluents and Ammonia*.

The conclusion to be reached from these works is that the best method of dealing with gas-works liquor at present is to recover the ammonia, in the form of sulphate of ammonia or other ammonium salts, at a central chemical works which is large enough to deal with the liquor from a group of undertakings. The cost of transporting crude liquor by rail to such a works generally exceeds the value of the ammonia recovered, and it is a further conclusion in the publication referred to that this uneconomical position can be rectified by the concentration of crude liquor at the gas-works where it is made to a liquor containing more than 15% of free ammonia, the concentrated liquor being then sent to the central chemical works.

The sale of crude liquor made by the undertaking which I serve did not realize the cost of its transport, and it was decided to install a concentration plant; but before proceeding with a scheme, leave had to be obtained from the City Council to discharge the effluent from the proposed plant into the town sewers. Strong objection to this was offered by the City Council.

The Public Analyst consulted by the City Engineer considered that the quantity of liquor effluent to be discharged would unduly raise the oxygen absorption figure of the sewage effluent, and that the phenols would render it toxic to fish. A counter opinion was obtained from the Liquor Effluents and Ammonia Committee of the Institution, but the Council was adamant until the Gas Company invoked the Public Health (Drainage of Trade Premises) Act of 1937. This Act grants permission for trade effluent to be discharged into the public sewers from any trade premises, subject to certain restrictions.

In order to obtain a typical effluent analysis on which an agreement with the City Council could be based, a 12-ton sample of crude liquor made by the Company was concentrated at a large chemical works, but preliminary negotiations were based on an estimate of the effluent calculated from an analysis of the crude liquor, as given below:

	Crude liquor. gm./100 c.c.	Calculated effluent analysis.	Test sample effluent.
Ammonia, free	2.08	0.02	0.011
" fixed	0.37	0.33	0.418
" total	2.45	0.35	0.429
Sulphide as H_2S...	0.238	—	—
Thiosulphate as S	0.162	0.146	0.061
Thiocyanate as CNS	0.295	0.265	0.295
Phenol as C_6H_5OH	0.360	0.270	0.221
Higher tar acids, parts oxygen absorbed per 100,000 in aeration test	32	29	29
Oxygen absorption by $KMnO_4$ in 4 hours at 80°F.—			
Due to sulphide	321	—	—
" phenols	641	481	393
" thiosulphate ...	139	125	52
" thiocyanate ...	244	220	244
" difference	225	202	258
Total...	1,570	1,028	947
pH value			7.3

The main conditions of the agreement finally made are as follows: The effluent to be free from suspended tar particles; it shall have a pH value of not less than 6 nor more than 10; it shall not consume more than 1,150 in 100,000 parts of oxygen from $KMnO_4$ in 4 hours at a temperature of 80°F. The effluent may be discharged only between 6 a.m. and 9 p.m. of any day at a uniform rate not exceeding 500 gallons per hour, and the total discharge in one day is not to exceed 9,000 gallons. The temperature must not exceed 110°F. The Company to provide and maintain a manhole or inspection chamber to facilitate the taking of samples by the City Engineer, also apparatus for measuring and recording the volume and rate of discharge of the effluent, all subject to inspection by the City Engineer. A charge of 3d. per 1,000 gallons, based on the meter readings, to be paid to the Corporation.

The extent to which the conditions relating to the constitution of the effluent are now being met will be shown by the figures given later.

Selection of Plant

The type of plant to be installed was considered from the following angles:

1. Suitability for dealing with the liquor made by the undertaking.
2. Steam consumption.
3. Automatic operation and flexibility.

* From a Paper to the Midland Junior Gas Association.

1. The crude liquor is made from the carbonization of Yorkshire, Derbyshire, and Forest of Dean coals in horizontal retorts, without steaming, and was of the composition given above.

The simplest type of concentration plant removes the free ammonia, carbon dioxide, and hydrogen sulphide from the crude liquor, and a product of 15% to 17% free ammonia can be made. The fixed ammonia can be removed by the addition of lime during distillation, but this complicates the process and adds to the labour and maintenance costs.

It has been proved that the strength of concentrated liquor that can be made from a given crude liquor without trouble from crystallization of ammonium carbonate in the product depends on the ratio of free ammonia to the carbon dioxide in the liquor, and that if the proportion of carbon dioxide to ammonia is greater than 1.36 to 1.0, then the concentrate cannot generally be of greater strength than 18 grammes of ammonia in 100 c.c. of concentrate without partial decarbonation of the crude liquor or of the product.

The main object in installing the plant was to reduce the cost of rail transport of the ammonia, and it was obvious that the greatest reduction would be made by manufacturing the strongest crystal-free product. As the NH_3/CO_2 ratio of the crude liquor exceeded 1.0 to 1.4, it was decided that a system embodying partial decarbonation should be employed and a product of 20% to 22% ammonia be aimed at.

2. *Steam Consumption.*—Partial decarbonation of the crude liquor is generally obtained by heating the liquor to a temperature of about 85°C. in a primary still or decarbonator, when CO_2, H_2S and small quantities of ammonia are dissociated, and then cooling the liquor in a heat exchanger before it enters the main still. The steam consumption for this partial decarbonation is about 20% of the total steam required.

The vapour phase system, which was finally selected, incorporates partial decarbonation of the still vapours and not of the crude liquor, and the preliminary heating of the latter is avoided, with a consequent economy in steam consumption. Also a proportion of the sensible heat in the still vapours is imparted to the crude liquor entering the still, and the exhaust steam from the liquor pump turbine is passed to the still, both factors reducing the quantity of live steam required.

3. *Automatic Operation and Flexibility.*—The obvious advantages of automatic operation are low labour costs, consistency in the product, and economy in steam consumption. The system selected has automatic control of the crude liquor supply, steam to still and water to primary condenser, together with a safety system for completely shutting down the plant in the event of blockage. The greatest flexibility is required in the control of condensation of the still vapours, to cope not only with variations in crude liquor throughput and strength, but also with variations in liquor and water temperatures. It is also necessary to vary the throughput of the still according to the variations between summer and winter makes of liquor.

The plant consists of a cast-iron ammonia still, a vapour liquor pre-heater, a primary condenser, a secondary condenser, a foul-gas scrubber, a crude liquor pump, "Arca" control equipment, a recording thermograph and gauges, effluent liquor cooler, balance tanks, filter and measuring device, a concentrated liquor storage tank, vent scrubber, and housing.

Crude liquor gravitates from an overhead storage tank to a centrifugal pump, which delivers the liquor through the preheater to the second section from the top of the still. The liquor passes down the still, and steam ascending from a distributor in the bottom section bubbles through the liquor in each section and strips it of its free ammonia, carbon dioxide, and hydrogen sulphide. The liquid level in the bottom section of the still is controlled by a float valve, from which the effluent flows through a tubular cooler to either of two concrete balance tanks.

The rate of delivery of crude liquor to the still is controlled by an "Arca" relay or thermostat at the vapour inlet to the preheater and an "Arca" valve on the outler of the pump to maintain a predetermined temperature of the vapours leaving the still and passing to the preheater. This temperature is such that refluxing takes place in the top of the still to permit only sufficient steam to leave the still as is required for absorption of the ammonia vapour to form the final product. The still-head temperature controls the strength of the product and is recorded on the thermograph.

A constant pressure of steam is maintained on the upstream side of an orifice plate in the steam supply to the still, by means of an Arca pressure control valve, and as the still-head temperature is controlled by the quantity of liquor delivered to the still the amount of steam entering the still (or the pressure at the orifice plate) governs the liquor throughput of the plant. An increase of steam pressure requires an increased volume of liquor to maintain the still-head temperature constant and vice-versa.

The vapours leaving the still are partially cooled in the preheater and are condensed in the primary condenser. When a mixture of

water vapour, ammonia, and carbon dioxide is cooled, it has been shown that the water vapour condenses and the water formed cools until it is able to absorb the ammonia and carbon dioxide. The rate of absorption of ammonia is rapid while the uncombined ammonia content of the water is low, but falls off as the ammonia content of the water increases and the concentration of ammonia in the vapour phase decreases. Further cooling of the water reduces the partial pressure of the ammonia in solution and more ammonia is absorbed.

The rate of absorption of carbon dioxide in clean water is slow, but as ammonium hydrate is formed the carbon dioxide combines to form ammonium carbonate, and the greater the concentration of uncombined ammonia in the water the greater the rate of absorption of carbon dioxide. Further cooling also assists the absorption of carbon dioxide.

Taking the process of condensation as a whole, the rate of ammonia absorption is rapid at first and then decreases, and the rate of carbon dioxide absorption is slow at first and then increases; and at one point in the process the concentration of ammonia in the vapour phase will be low and the concentration of carbon dioxide relatively high. If the condensate is separated from the gases at this point the ratio of carbon dioxide to ammonia in the condensate will be much lower than if condensation had proceeded until equilibrium was reached between the vapour pressures of ammonia and carbon dioxide in the gaseous and liquid phases.

The liability to crystallization of concentrated gas liquor depends on the ratio between the ammonia content and the carbon dioxide content, and a strong crystal-free product can be obtained if the carbon dioxide content is low. Therefore, in the system under consideration, the free condensation of the still vapours is interrupted by bleeding off a proportion of the gases and vapours at the outlet of the primary condenser. This effects partial decarbonation of the still vapours, and the degree of decarbonation is determined by the temperature at which separation of the vapours and condensate takes place. The higher the temperature the greater the decarbonation and the greater the proportion of ammonia passing away with the waste gases for subsequent recovery. This temperature is referred to as the vapour bleed temperature, and is automatically controlled by an "Arca" regulator governing the supply of cooling water to the primary condenser and is recorded on the thermograph.

The gases removed from the primary condenser outlet consist of carbon dioxide, hydrogen sulphide, ammonia, and hydrogen cyanide; and they pass to a ring-filled foul-gas scrubber, where they are washed first with crude liquor and then with clean water for absorption of the ammonia. They are then conducted to an oxide heap for the removal of hydrogen sulphide before being discharged to the atmosphere. The wash liquor from the foul-gas scrubber is returned to the works liquor well strengthened by the absorption of the ammonia bled from the condenser. This is recycled ammonia and the liquor well can be considered as part of the recovery system, wherein the crude liquor is fortified, while the heat required for recovery of the recycled ammonia is only that required for the distillation of a quantity of liquor equivalent to the quantity of water fed to the scrubber.

The condensate from the primary condenser flows through a secondary condenser where absorption of the remaining gases is completed, and the product is cooled before flowing through a seal and sight box to the storage tank.

The plant is designed to concentrate 8,000 gallons of crude liquor per day, containing 2.08% free ammonia, and from its free ammonia content to produce concentrated gas liquor containing 20%–22% ammonia by weight.

Working of the Plant

During the twelve months in which the plant has been at work we have been well pleased with the working and the results obtained. Various operating temperatures, steam pressures, and liquor throughputs have been worked, the object being to obtain the strongest product consistent with a low ammonia content of the effluent and absence of crystallization blockages. At different times blockages have occurred in the primary condenser, secondary condenser, gas offtake from the scrubber, and the scrubber drain. To prevent blockages occurring the steam purge points are operated every eight hours and the whole plant is steamed out on the first indication of excessive pressures. It is of interest to note that condenser blockages are much less frequent when the plant is worked at the full capacity of the condenser.

A restriction in the scrubber drain was caused by a scale consisting of calcium carbonate with traces of calcium sulphide, tar and iron. Short lengths of this steel pipe have been renewed owing to corrosion. The steel pipe passing hot liquor from the preheater to the still has also been replaced by a cast-iron pipe.

Approximately 2¼ million gallons of crude liquor have been concentrated, the strengths varying from 1.77% to 2.70% free ammonia. The high ammonia content of the wash liquor from the scrubber, being returned to the works well, tends to increase the strength of the crude liquor delivered to the plant after a few weeks' working, and can give misleading figures when calculating the period performance of the plant.

The concentrated liquor sold amounts to 828 tons, of an average strength of 19.92% free ammonia on a weight volume basis, and the sale of this has realized £787 16s. 10d.

The cost of concentration is made up as follows:

	£	s.	d.
Labour, plant attendant	87	16	2
Labour and materials for sundry repairs ...	15	4	9
1920 tons of steam at 1s. 6d. per ton	144	0	0
Grease, oil and charts	5	13	6
Interest on capital, 6½% on £5,100	306	0	0
Disposal of effluent (2,680,000 gallons at 6d. per 1,000)	67	0	0
	£625	14	5

A profit of £162 2s. 5d. is shown over the year, while the Company paid over £2,000 for the disposal of crude liquor during the previous year.

I wish to record my thanks to Mr. W. E. Caton for his permission to write a Paper on this subject, and to Messrs. Newton Chambers & Co., Ltd., the makers of the plant.

Mr. **F. J. Bengough** (Birmingham) proposed a vote of thanks to the Author. He asked if the plant worked continuously and if there was sufficient storage capacity to allow the plant to be shut down, particularly in the event of a breakdown. The "Arca" control appeared to be very efficient.

Mr. **K. L. Pearce** (Bilston) seconded. He said he was much interested in the difficulties which arose with the local authorities. It was a matter of regret that a valuable by-product often had to be disposed of in a variety of ways, and it had taken another war to make people realize its value. He wondered what would be the position after the war and whether the market would be maintained. The Paper provided much valuable data for those who contemplated the installation of such a plant.

Mr. **Bentley,** replying, said the plant was continuous and had been worked for two or three months without a shut-down. Every four or five days the plant had to be steamed out, but that was a safety precaution and was quite normal. As regards storage, they had approximately 20 days' capacity, so they could shut down for three weeks and still not have to dispose of liquor. The cost of installation, he thought, would be amply justified. In three years the plant would be paid for, and that included an allowance for capital interest. While he could not forecast the future position, he considered that even if payment had to be made for liquor to be carted away it would still pay to concentrate.

National Gas Water Heaters

Substantial developments in the manufacture, sale, and servicing of gas water heaters are contemplated in a programme now being prepared for post-war operation as the result of a reorganization in the control of the National Gas Water Heater Company. Proprietorship of the Company has now been taken over by Serck Radiators Ltd., who have purchased the whole of the American interests, and who, with their own long record of service in the heat transfer and non-ferrous tube industries, have extensive facilities for dealing with the manufacture of gas water heaters. Complete manufacture of all appliances, including the making of their own copper tubes, will be carried out in the Company's own factories.

Fourteen branches conveniently situated throughout the British Isles will afford co-operative service, both in regard to technical and sales problems, and these "service stations" will always be at the disposal of the Gas Industry. The branches, which are already being adapted for their specialized functions, are in London, Sudbury (Suffolk), Chester, Cardiff, Manchester, Newcastle, Southampton, Glasgow, Maidstone, Brighton, Belfast, Kilmarnock, Carlisle, and Dublin.

The range of appliances will include sink heaters, multi-point (continuous flow) heaters, storage heaters of various capacities, circulators, and large volume hot-water supply units. Arrangements have also been made for close co-operation with the Ruud Manufacturing Company of America, which has been manufacturing gas water heaters since 1839.

It is nearly twenty years since the "National" organization was set up, first as a British branch of the Ruud Company, and a little later in its own name as the National Gas Water Heater Company. In the early days it manufactured its appliances at Slough and had sales offices in Holborn. Later it removed to Wembley, where it outgrew its accommodation, and a large new factory, with showrooms and offices, was completed about the time the war started, but in course of time these premises have been diverted to war purposes.

Mr. Edgar C. A. Bliault, who has directed the activities of the Company for seventeen years, has agreed to remain with the new organization as consultant.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

INSTITUTION DISCUSSION

WRITTEN CONTRIBUTIONS ON COMMUNICATION No. 259

(*Continued from p. 239*)

THE DESIGN OF THE DISTRIBUTION SYSTEMS TO SUPPLY POST-WAR DEVELOPMENT

By H. J. ESCREET

Mr. **L. B. Chapman** (Skipton) wrote: I should like to supplement Table I of the Paper with the example of a direct supply from a high-pressure holder to the low-pressure mains during peak-load periods. My Undertaking installed such a holder of 250,000 cu.ft. capacity in 1933, 1½ miles from the source of supply. The case is comparable with the Author's town of 5,000 houses, and in order that the figures may be comparative I have calculated the following costs on the basis of 500,000 therms transmitted per annum.

Capital cost of holder (including trunk main), 0.17d. per therm.

Transmission (including compressor and governors), 0.54d. per therm.

The maximum terminal pressure is 50 lb. per sq. in. and the pressure at the governor outlet is 4.5 in. These costs imply a criticism of the capital costs given in Table III. The cost, in competitive tender, of the high-pressure holder to which I refer was £6,100, including the trunk main, and the annual charge to the Undertaking amounts to £340, against the £15,000 and £975, respecitively, mentioned in the Paper.

I can confirm the Author's remarks regarding maintenance, and indeed the outstanding feature of the Skipton holder has been the low cost of maintenance. This amounts to a total of only £200 over a period of 10 years, which is under 0.01 pence per therm of gas sold.

A study of the Paper, together with experience gained with a high-pressure holder, leads one to the conclusion that when transmitting distances of 10 to 25 miles for storage capacities up to 250,000–350,000 cu.ft. high-pressure local storage is more economical and serviceable than a low-pressure storage system.

Mr. **B. R. Parkinson** (Parkinson & Cowan (Gas Meters), Ltd.) wrote: Mr. Escreet's Paper is of greater significance than would appear from its modest introduction. To one who has followed the progress of high-pressure distribution it would appear that either consciously or unconsciously he introduces us to a new epoch in the distribution of gas. This can be best appreciated by a brief historical survey.

The Gas Industry has, or had, its roots in the time when ½ in. W.G. was all the pressure required for the flat-flame burner. At the very beginning there was nervousness over the distribution of an inflammable gas in mains and services, even at the lowest pressure, and up to comparatively recent times district pressures have been haunted by water-slide chandeliers and water-sealed meters. The older gas engineer thought only in terms of pressures which were attained by building the Gas Works on the lowest site in a town, that being one of the foremost tenets of the profession. At the turn of the century the advent of the Bunsen burner and the dawn of the industrial load made necessary the introduction of boosting plants to supplement holder pressures, and these were accepted conservatively.

The pioneers of anything approaching a full-scale high-pressure system were the Mid-Kent Gas Light and Coke Company, whose system was described by myself in the *Gas World* on January 9, 1909. The explanation of this enterprise lay in the association of that Company with the Mid-Kent Water Company. The management had been trained, not in the gas tradition, but as water engineers, supplying 150 villages throughout the country by 300 miles of main, and handling pressures up to 250 lb. per sq. in. To them it came quite naturally to distribute gas in a similar manner, and they pumped it over many miles through steel tubes into distant holders. About that same period there was considerable publicity given to the St. Louis scheme in the United States, where a belt line of high-pressure main was run round the outskirts of the city to reinforce the existing low-pressure mains radiating from the centre. From then until now high pressure has been employed more and more, either for transmission or reinforcement, but the high pressure has still figured merely as an auxiliary. Mr. Escreet's Paper now marks the end of the apologetic stage; the high pressure is no longer merely an adjunct, kept on the outside as at St. Louis, but is invited in to form the backbone of a considered scheme. For the first time a high-pressure plan is conceived entirely *de novo* and in its right perspective. That is in keeping with a paragraph in Mr. Evans's Presidential Address, referring to the place which the Gas Industry as a whole has achieved in the sphere of national fuel economy: "Each (branch of the fuel industries) developed from small beginnings to meet a special need, and each has grown in size and achievement until now it is possible to assess the most profitable lines of future development."

Mr. Escreet draws attention to the effect of higher terminal pressures upon the loss of pressure in the main, showing that the transmission pressure loss is less in the higher regions than in the lower. Some 25 years ago I published charts in which the comparative discharges were shown for given losses of pressure progressively from 5 lb. up to 100 lb. This demonstrated that the relative discharge for a drop in pressure of 1 lb. per sq. in. from 100 lb. to 99 lb. was 2½ times as great as from 5 lb. to 4 lb. At that time no costs were available to show whether advantage could profitably be taken of these higher pressures, but now Mr. Escreet's figures show that the forecast was not unreasonable.

Mr. **L. H. Pinkess** (Evered & Company, Ltd.) wrote: The Author says "A good case could be made for fitting (service) governors to all low-pressure supplies as part of that better service to consumers which it is hoped to provide in the future." He then uses supporting arguments. This is one answer to the statement made in the Report of the Committee of Enquiry on Gas Quality that "the greatest source of complaint by the consumer is excessive variation in gas pressure at his appliances." But there is another answer. It will not have escaped the notice of the Industry that there was before the war a rapidly growing tendency for manufacturers to send out all important appliances complete with built-in governor. The reason was the perfectly sound one that having produced an appliance of high performance they wished it to operate wherever fixed in a definite way. They had therefore to assume responsibility themselves for supplying the appliance at a known pressure and so they incorporated a governor. Now appliance governors, although cheaper per unit than service governors in a complete installation for a house, will cost more in the aggregate than the corresponding service governor. The maintenance costs for the appliance governors in the aggregate are also likely to be larger. So the appliance governor answer to the problem of pressure control will cost more than the service governor answer. The service governor will therefore be preferred for cases where, as in all new installations, there is adequate carcassing. Unfortunately there is always a proportion of houses, as Mr. Escreet indicates, where, because of the resistance of the piping, the service governor will not provide sufficiently constant pressure to appliances. Here the built-in governor is the only solution.

My reason for repeating these arguments, which are commonplace to all who have thought about the matter at all, is to urge upon distributing engineers the necessity for an early decision on governor policy. Surely it is on them that the responsibility rests for the supply of gas at a constant pressure. Yet if they do not make up their minds, the appliance makers will be forced to take the responsibility for the decisions. Their answer will be adequate, but it will cost more than it need. It would therefore be necessary for engineers to survey their districts, probably by applying some simple criterion in examining records of installations, and to decide what proportion of their consumers require service governors, and what proportion require appliance governors. If this were done on a sufficiently wide scale it would be possible for the Gas Undertakings and the appliance and governor manufacturers to co-operate to use governors in the best way for all consumers. Governors have come to stay. The important thing is to use them to the best advantage.

THE DESIGN AND SUPPLY OF DOMESTIC GAS APPLIANCES

By J. E. WHITE

Mr. **A. Bujnowski** (Glasgow) wrote: The ultimate aim of the Industry must be the best possible service to the consumer. After all this is our function. To achieve this the requirements of the consumer must be considered in the fullest possible sense, and these requirements rigidly applied to all forms of utilization. The Gas Industry can provide the domestic consumer with a complete fuel service. This should be the aim, and every effort must be directed towards realizing this. There is much to be done. Apart from post-war developments there is still a very considerable number of out-of-date appliances which must be replaced. The Industry must speak with one voice. We must be agreed on policy and tariffs, but I am afraid there is still considerable variance throughout the country on these matters.

I like Mr. White's term "operational efficiency." The consumer is not concerned whether the production efficiency or the thermal efficiency of the appliance is 9 or 90 per cent. What does concern the consumer is the service given by the particular appliance. This, co-related to cost, gives the only efficiency which ultimately matters. The efficiency of production and utilization are certainly contributory, but these must not be taken so far as to affect the "operational" or "service" efficiency.

I feel that there must be some definite policy regarding water heating. Here gas gives a service second to none. Our instantaneous heating is unassailable. However, it would appear that for the immediate future the circulating type will be more suitable. Water heaters do require maintenance, and if this maintenance can be reduced or eliminated then a considerable advance will have been achieved. This should be possible by attention to gas quality, and also the application of a suitable type of metal for the vital parts. I think some standardi-

zation of water heater capacity should be decided. Personally I feel that the 15,000 B.Th.U. per hr. machine is rather small. I favour a machine with a capacity of 30,000 B.Th.U.

The space-heating field is one to which the fullest possible attention and effort must be directed. The particularly desirable conditions attending space heating by means of gas fires are well known. It must be borne in mind, however, that there are other factors which determine these ideal conditions. During the last 15 years gas fires were condemned on many occasions as unsuitable, unhygienic or unsatisfactory in many ways. In very few cases were these criticisms justified by the appliance alone. Invariably the cause of the trouble was the method of fitting, and the type of flue. This seems a matter which must have the whole-hearted attention of the Industry, together with the fullest possible co-operation and understanding on the part of architects and builders. It might be that the best course would be to arrange for normal flues capable of taking solid fuel fires; then the Industry would have the choice of coke, smokeless fuel or gas.

Regarding cookers, I think my remarks in connexion with service efficiency apply particularly. Whether the hotplate is of the solid-type variety or not seems a very moot point. However, as the bulk of the cooking is done on the hotplate—particularly in Scotland—I think every attention should be given to improvement in hotplate service. If the introduction of a solid top must mean additional maintenance, then I doubt if it will be worth while. I am afraid I cannot agree with the position of the cooker in Mr. White's small kitchen. It is admitted that unit construction will almost certainly be applied to many, if not all, post-war houses, but placing the cooker in such a position that the working space is restricted—and the actual light falling on the cooker is by no means sufficient—does not seem to me to be too sound. I feel that the average housewife would desire more room, possibly by an extension of tables or other units on either side. In addition, as cooking is a most important part of the housewife's duty, the best possible working conditions on the cooker top should be provided. The ventilating canopy is very desirable, and I presume this canopy, with its outlet, would have adequate access for cleaning. While appreciating the fact that the apparatus shown can be fitted into the small space mentioned by Mr. White, I wonder if it is wise to stress this too far. After all the aim of post-war planning is to provide the housewife with a kitchen as near perfection in every way as possible. I feel, therefore, that the maximum conditions of comfort—light, heat and convenience—must be incorporated, as they can be.

I completely agree with Mr. White's suggestion that the assistance offered by electricity should be accepted and applied. I think automatic ignition should be much more extensively employed.

Although perhaps rather outside the province of the Paper, I would suggest that unless the many splendid facilities the Industry has to offer can be incorporated in post-war building, the result will be serious. This means suitable staff, trained in the knowledge of appliances and their suitability, plus the necessary liaison and co-operation with the appropriate authorities. I hope this real need is appreciated.

Mr. J. W. Pallister (Middlesbrough) wrote: In dealing with the subject of water heating, the Author refers to only one type of heater, the circulator. Does this mean that he considers this to be the ideal form of heater for the general hot-water requirements of the average family house? If so, I am in agreement with him, and had reached this conclusion and begun to formulate a sales policy accordingly, just prior to the war, which has, of course, suspended activities. Sink heaters and single-point bath heaters of the instantaneous type are invaluable in certain circumstances where facilities for hot water supplies are inadequate or non-existent, and multi-point heaters also have their limited uses; but for a constant and ample supply of hot water with the minimum of trouble and maintenance, I recommend the circulator unhesitatingly. I agree with the Author that gas circulators should be of simple, rugged construction, and of ample size proportionate to the duty to be performed, and it was a heater of this type on which we concentrated, to the exclusion of other types on the market which, though cheaper, appeared obviously too small for their output.

We have found the greatest scope in Middlesbrough in the installation of gas-heated circulators in parallel with the existing coal-range boilers, and utilizing the existing storage cylinders. Many consumers make use of the gas circulator principally in the summer months when the coal fire is not in use, and this is certainly a much better seasonal load from the point of view of load factor than, say, the gas fire. We provide an adequate hot water supply throughout the year from a gas circulator in houses where no coal whatever is used, at a cost of 2s. 5d. per week at the ordinary domestic rate. This provides an annual consumption on the circulator of 300 therms of gas. It has been estimated that the heat allocation for the normal family for water heating is 50 to 70 "useful therms" per annum (equivalent to 100 to 140 therms of gas) as a "reasonable minimum." I would certainly consider this allocation to be insufficient, but, by comparison, the hot water supply provided by the 300 therms of gas per annum (equivalent to 150 useful therms) would appear to be adequate as, in fact, is proved in practice.

The Author makes brief reference, no doubt with some temerity as to its reception, to the introduction of electrically-operated devices to gas appliances, which I think he could, with advantage, have developed in greater detail. Mains-electric ignition of all cooker burners and gas fires will inevitably replace the flint-and-steel devices now in use; and surely a gas-heated wash boiler with electrically-operated wringer and agitator would be a "best seller."

Mr. H. F. Potter (R. & A. Main, Ltd.) wrote: Because of the war the Author's comments on, and illustrations of, appliances are of necessity based on types which will be changed to some extent in the post-war period. As an instance, in fig. 5 the fixing of the thermostat on the oven side has prevented the side fitment going up to the cooker. The use of a thermostat fitted on the cooker front will improve this lay-out. The partial closing-in of the base of the cooker in this lay-out will not appeal to those housewives who are always fearful about dust traps, and prefer the clean slender supporting legs with plenty of brush room.

The hot closet shown in fig. 5 could perhaps be brought down to an easier height for working. Why not embody it in the plate rack as its maker does? Also why not go even further and have a good sized griller fitted to the base of this closet, with folding-up grill-pan carriers. This would give an eye-level large griller and allow an extra boiling ring to be fitted in the cooker hotplate in place of the usual smaller grill, thus providing a larger hotplate, easier to clean, and with additional plate-warming space under it, with no burning-up of the oven crownplate. (I ought to add that a provisional patent has already been granted for this idea.)

Solid hotplates in one form or another have been in and out of the gas appliance market a dozen times in my knowledge, and makers of experience will certainly be wary of taking further risks. To some extent these remarks will apply to the use of luminous flame burners.

THE DESIGN AND PERFORMANCE OF GAS-WORKS PLANT

By A. G. GRANT

Dr. **N. Booth** (Fuel Research Station) wrote: The Paper throws a very interesting light on gas-works plant from the designer's point of view, and there is little in it that scientific men are likely to dispute. The Author contends that the user of the plant should appreciate the scientific attitude, and I take it that by the user he means not only the manager and the technical staff, but also the foremen and plant operators. At the Fuel Research Station we have had experience of the complete examination of plant of various types, and can fully support the value of a thorough scientific study by competent observers. Such a study is likely to suggest immediate modifications and improvements of direct value to the user and would seem therefore to be primarily his concern. Further than this a series of studies under different operating conditions will probably enable general conclusions of permanent value to be drawn, and the most rational way of dealing with this would seem to be for the designers of the plant to collect and collate test data provided by individual users. In this connexion experience has shown the wisdom of collecting as much test data as possible, perhaps even blindly on occasion, because in the course of time it may be the key to some difficulty, and it would be almost impossible to carry out special tests in order to obtain the missing data. There are probably few Works in which the qualified technical staff can make comprehensive and prolonged observations on a new plant installation, but much useful data can be collected with the aid of junior staff and operatives who understand the scientific point of view sufficiently to realize the importance of these observations. This implies a suitable technical training of the ancillary staff.

The Author has pointed out that chemical engineering is a science of recent growth, and Dr. King has expressed the view that more attention should be paid to it in this country. The Universities, with a few notable exceptions, relegate chemical engineering to a very inferior position. It would probably be a good thing for chemical industries, such as the Gas Industry, if the Universities turned out less students with research degrees and more with chemical engineering diplomas. Such training is likely to be more useful for investigations of the type the Author envisages than is a research qualification. Other countries, and notably the U.S.A., have paid far more attention to this problem than we have, and it is just in this question of plant design and development that they are prominent.

In addition there would seem to be room in technical colleges for part-time courses in chemical engineering of a more elementary nature. At present there are on the one hand courses in chemistry or mechanical engineering which tend to be academic in nature, and it has been my experience that only when a young man in chemical industry is shown the practical application of the academic topic that he is really interested. On the other hand, in view of the possibility of the introduction of new processes involving high-pressure technique, liquefaction of catalysis, it is suggested that it would be valuable to have courses of wider scope than gas or fuel technology. The introduction of a national certificate in chemical engineering would help to fill this need. The Gas Industry is developing along less empirical and more scientific lines. This implies that all engaged on the production side at least should acquire a scientific outlook and scientific knowledge, and I feel that this is essential before the attitude of the user to plant performance is all that the Author would like it to be.

WRITTEN REPLIES TO DISCUSSIONS ON I.G.E. JUNE PAPERS

J. E. DAVIS

Mr. J. E. **Davis,** in reply, wrote : First I should like to thank Mr. Finlayson for emphasizing the warning contained in the Paper, that this method of examination of a complex problem does not provide a reliable short cut to the determination of an accurate cost of gas production. The problem that was to be studied was whether any particular calorific value showed such intrinsic advantages or disadvantages that its adoption was to be encouraged or deprecated. In making an examination of this type it is important to be as free as possible from the limitations of present technique. Plant and processes are constantly improving, and conclusions based upon working data at any one particular stage of development could obviously only have a temporary value. While this method of eliminating what may be temporary limitations is justifiable in a general examination of a problem, it is, of course, quite out of place in dealing with a particular instance: the difference between the two may well be indicative of the scope available for further development of technique.

Dr. Pexton's contrast between alternative methods for apportioning the cost of coal between products is another example of the same differences between the ideal case and the practical case as limited by present technical achievement. I do not know quite whether to take seriously the suggestion of varying the calorific value between summer and winter in order to eliminate the difficulty of stocking coke, but I hope that the suggestion was not inspired by anything in the Paper, for I cannot feel that its adoption would result in uniform and satisfactory performance of the consumers' appliances.

I am sorry that Mr. Leather was disappointed, but perhaps if he refers to my remarks on Mr. Finlayson's contribution, he will see that the Paper was not intended to show the costs in specific cases.

The suggestion that the intensity of heat production per unit volume of flame is determined by the ratio between air entrainment and air required for combustion is an interesting one, but I cannot help feeling that if this effect were anything like so great in magnitude as Mr. Leather suggests, the difference in performance of appliances burning gases of different calorific values would surely have become obvious long ago. The fact is that gas appliances are working, and working satisfactorily, on a very wide range of gas qualities, and that when the appliances are properly adjusted for the quality of gas they consume, the differences in performance are so small that they have hitherto escaped detection.

H. J. ESCREET

Mr. **H. J. Escreet,** in reply, wrote: I am grateful to Mr. Masterman for opening the discussion, and am very pleased to know that he considers that the Industry should anticipate a consumption of 250 therms per consumer per annum. As, however, he states that the consumption in the 10 years to 1937 averaged less than 80 therms per consumer, I fear that I should have been accused of undue optimism if I had taken a figure even approaching 250 therms as the basis of my Paper. Although the distribution charges per therm would be substantially reduced by such an increase in load there is not, so far as I know, any reliable information sa to the load factor corresponding to that consumption, and therefore many assumptions would have to be made in working out the costs of distribution. The costs for pumping, transmission, main and local storage would all be increased by the greater daily demand, and it would be surprising if the cost per therm were reduced to one-third of those quoted in the Paper.

I am glad, also, to have Mr. Masterman's opinion that the estimated maintenance charge for service governors of 3s. per year is much too high. The lower this charge is the better the case which can be made for universal use of service governors. I agree that there would have to be some standard pressure for the setting of service governors if these were to be used in place of appliance governors, whilst retaining the advantages of fixed settings of the appliances.

Mr. Tate refers to the probability of the provision of underground conduits for public utility services in future towns, and although he considers that the smaller mains which are made possible by distribution at intermediate pressure would be an advantage in such conduits, he fears the effect of the damp conditions upon welded steel pipes. I do not think that conduits would really be such a great advantage to the road user as is made out by many municipal engineers, but if they were provided I think that public utilities should insist that they were properly drained and ventilated, and of sufficient size to enable the various services in them to be inspected and maintained without undue difficulty. If these conditions were satisfied I see no reason why steel pipes with welded joints should not be quite satisfactory.

With regard to Mr. Tate's suggestion for a service governor combined with excess-pressure cut-off valve, I feel that as the cut-off valve would only come into action in the event of failure of the governor, it would in practice be required to operate so seldom that it would probably fail to work when needed. I agree that governors should not be allowed to vent into a confined space, and in the case of large blocks of flats it might be necessary to run a rising pipe to which the vents from all the governors could be connected, this pipe being taken clear of the roof.

Mr. Tate raises an interesting point with regard to the relative maintenance charges for cast iron and steel mains. The 8 per cent. charge is made up of interest, depreciation and maintenance. The rate of depreciation required depends upon the expected life, and in the case of steel pipes this is governed by the corrosive action of the soil and the degree of protection afforded to the pipe by wrapping, etc. I think much more attention must be given to this in future, and it may well be necessary to protect steel pipes by concrete if they are laid in corrosive soil. Apart from corrosion, maintenance is largely a matter of remedying leaky joints—with welded steel mains this expense should be eliminated and the decrease in maintenance would allow of a higher figure for depreciation. The use of mechanical joints for cast-iron mains should reduce the leakage from joints, but experience of the life of such joints is at present lacking.

I agree with Mr. Tate and Col. Gould that the numerous reports and schemes for post-war planning are very confusing, and it is quite impossible to forecast the development in one's own area until much more definite schemes for post-war planning have been evolved. I do feel, however, that if such schemes are produced within the next year or two and given full statutory force we should be enabled to foresee the lines of development for some time ahead.

I agree with Mr. Dyde that there might be considerable difficulty in arranging for a number of holder stations round a town, but if it were possible to arrange for these it would reduce the cost of local trunk mains. This applies particularly in the case of high-pressure storage.

The figures which Mr. Dyde gives for the cost of anti-freezing protection are very interesting, and serve to emphasize the advantages of high-pressure storage in this respect.

Col. Gould raises an interesting point as to the maximum safe pressure for gas mains running through towns. I do not think any definite ruling could be given on this point, but would say that mains at pressures above, say, 50 lb. per sq.in. should preferably be kept out of the densely populated areas. If this cannot be done, then special attention should be given to the jointing and protection of the mains, the provision of valves, etc., so as to reduce the possibility of escape, and make the controlling of the main in the event of serious damage as simple as possible. I should certainly recommend the use of steel mains with welded joints for such pressures.

Mr. Robinson suggests that the ratio of the maximum day's consumption to the annual consumption of 1 in 200 is too high, and that this would probably lie between 1 and 250 and 1 and 300. This ratio will, of course, depend on the type of load, increase in the domestic heating load tending to increase the ratio, while increase in the industrial load tends to decrease it. I agree that each case must be judged on its own merits. I think Mr. Robinson must have misread my Paper when he says that I visualize supplying districts at pressure between 60 lb. per sq.in. and 1 lb. per sq.in. Actually the supply at intermediate pressure would be in the range of 1 to 10 lb. per sq.in., the higher pressures only being required for transmission and storage, although some consumers might be supplied direct from the transmission main.

While I agree that the governors should be designed for a reasonable range of inlet pressure, I have found on our Grays high-pressure system that the service governors function quite satisfactorily over a range of from 5 to 40 lb. per sq.in. I do not think there would be any advantages in operating relay pumping stations except on very long transmission mains, as generally speaking pumping costs would be considerably increased.

I am grateful to Mr. Chapman for the figures he gives of the actual cost and maintenance charges on the 250,000 cu.ft. capacity high-pressure holder at Skipton. The costs I gave for high-pressure holders were based on 1938 prices, and on capacity over the working range from 50 to 10 lb. per sq.in. I do not know whether Mr. Chapman's capacity of 250,000 cu.ft. is for this range, or for the full range of 50 lb. down to atmospheric pressure. I believe, however, that the Skipton holder was one of the first, if not the first, to be installed in this country, and it certainly appears that it was obtained at a very favourable price. Moreover, prices rose considerably between 1933 and 1938. I note that Mr. Chapman quotes an annual charge of £340 on the £6,100 capital cost of the holder. This is approximately 5½ per cent., as compared with the figure of 6½ per cent. which I used, and I am glad to have confirmation that the maintenance charges on high-pressure holders are so low.

I am grateful to Mr. Parkinson and to Mr. Pinkess for their contributions, but do not think there are any items upon which I need comment.

To Cope with the increasing difficulty of getting spare parts the Gas Light and Coke Company has instituted a wartime welding service. Consumers are invited to bring any broken part of their cooker, water heater, or fire to the nearest gas showroom, and to get an estimate for repairing it. Before the repair is undertaken the consumer is told what the cost will be. Where it is not possible to bring in the broken part a representative of the Company calls and examines the appliance. An estimate is then submitted. The service is proving very popular, and several repair shops have been set up to serve the Company's area; it has been necessary to train additional welders to carry out the work.

Correction.—In the FlinTop Distributing Co. Ltd. advertisement in the "JOURNAL" of Aug. 18, the price of the Double FlinTop Pocket Lighter is given as 5s. 6d. retail. This price should have been 5s.

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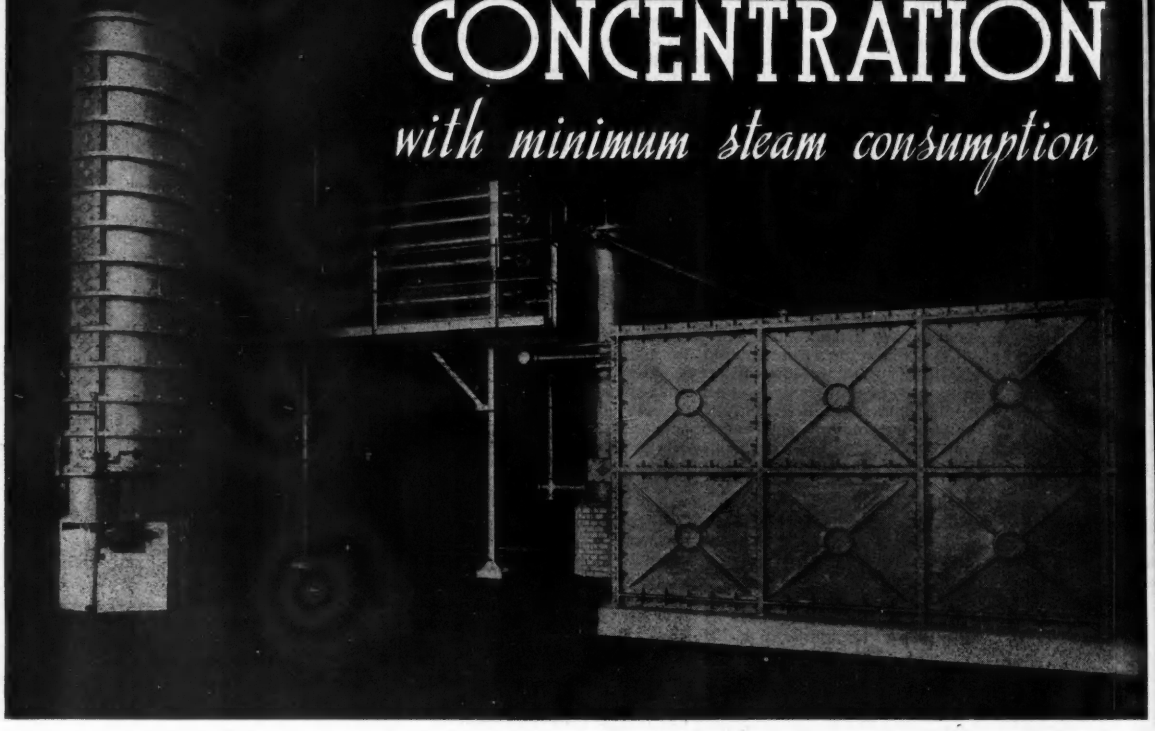

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GAS PRODUCTS PRICES

The London Market Aug. 30.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

A new Order entitled The Control of Toluene (No. 3) Order, 1943 (S. R. & O. 1943, No. 976), came into force on July 20, and introduces certain changes in the prices for different grades of Toluene.

There are no changes to report in the prices of Coal Tar Products.

The Provinces Aug. 30.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, 1943, dated July 14, operative from July 20, 1943). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, and anthracene controlled by the Coal Tar Products Prices Order S. R. & O. 2509, dated Dec. 7, 1942, and operative from Jan. 1, 1943. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5½d.; timber preservation and other purposes 4½d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 o the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Aug. 28.

Production and demand are well balanced. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7½d.; neutral oil, 6d. to 6½d.; hydrogenation oil, 5¾d. per gallon; all *ex* Works in bulk. Refined cresylic acid continues active, both home and export, at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in bulk, 90/180 grade 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

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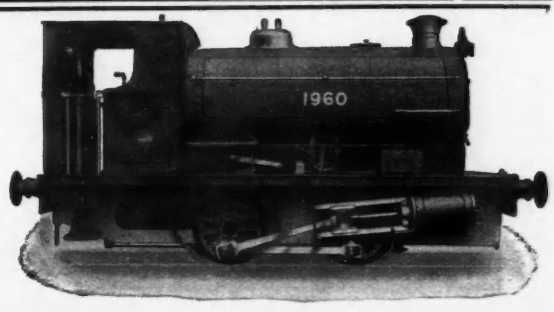

GAS STOCKS AND SHARES

The volume of business in the stock markets was about level with that of the previous week. Events in Quebec led to some bright patches here and there occasionally, but the week closed on a quiet note with a steady tone.

There were no special features in the Gas Market, and here also the number of recorded transactions varied little from that of a week ago. Prices remained steady with few changes, the only increases of note being that of Alliance and Dublin ordinary, which gained 5, and in the Supplementary List Tunbridge Wells sliding scale stock, which on support closed 4 points higher at 124½.

Compared with the quotations shown in the list a month ago, although the number of improvements was less than usual, the dividend announcements by the Gas Light & Coke Company (ordinary and preference) and the South Metropolitan Company (preference only) gave a fillip to the stocks of the three Metropolitan Companies.

The following price changes took place during the week:

PROVINCIAL EXCHANGES

Hartlepool Ord. (x.d.)	86—88	Aug. 23
Newcastle 4 p.c. Pref.	99—101	+1

OFFICIAL LIST

Alliance & Dublin	100—105	+5
Commercial 5 p.c. Deb. (x.d.)	108—113	Aug. 23
Croydon Sliding Scale (x.d.)	121—126	"
Ditto max. Div. (x.d.)	101—106	"
Imperial Continental	91—94	+1
Mid-Southern Utility "C" (x.d.) ...	95—100	Aug. 23
Ditto 4 p.c. Pref. (x.d.)	89—94	"
Primitiva Holdings, Ltd. Ord. ...	11/6—13/6	—/64.
United Kingdom Gas Corporation Ord.	20/9—21/9	+—/3d.

SUPPLEMENTARY LIST.

Croydon 4 p.c. Pref. (x.d.)	89—94	Aug. 23
Mid-Southern Utility "A" Ord. (x.d.)	90—95	"
Tunbridge Wells Sliding Scale ...	122—127	+4

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Aug. 26
1,767,439	Sept. 7'42	5	5	Alliance & Dublin Ord. ...	100—105
374 000	June 28	4	4	Do. 4 p.c. Deb.	95—100
583.407	May 10	5	5	Assed. Gas & Water U'd'ts Ord.	19/6—20/6
388,938	"	—	—	Do. Deferred	19/6—20/6
500,000	"	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/3—20/3
535,545	"	4	4	Do. 4 p.c. Red. Cum Pref.	19/6—20/6
341,966	"	4	4	Do. 4 p.c. Irred. Cum. Pref.	17/6—18/6
561,370	Aug. 16	7	7	Barnet Ord. 7 p.c.	153—158
300,000	June 15	1/4⅛	1/9⅛	Bombay, Ltd.	23/—25/..
690,407	Aug. 16	7	7	Bournemouth 7 p.c. max. ...	148—153
362,025	June 15	4	4	Do. 4 p.c. Deb. ...	105—110
659,955	March 15	2½	2½	Brighton, &c., 5 p.c. Con. ...	87—92
855,000	"	6	6	Brit. Gas Light Ord.	108—113
545,000	June 28	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115
120,000	" 15	4	4	Do. 4 p.c. Red. Deb.	92—97
10,000	Nov. 6'33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	45/—65/—
626,860	July 19	6	6	Cardiff Con. Ord.	110—115
24,500	June 15	7	7	Colombo 7 p.c. Pref.	21/6—23,6
764,169	March 22	-/9.56	-/9.56	Colonial Gas Assn. Ltd. Ord. ..	⅛—¼
400,000	"	1/3.298	1/3.298	Do 8 p.c. Pref. ...	⅛—¼
1,748,090	July 22 '40	2	3	Commercial Ord.	70—75
620,000	June 7	3	3	Do. 3 p.c. Deb.	66—71
286,344	Aug. 23	5	5	Do. 5 p.c. Deb.	108—113
807,560	" 23	6	6	Croydon sliding scale	121—126
644,590	"	5	5	Do. max. div.	100—105
620,385	June 28	5	5	Do. 5 p.c. Perp. Deb. ...	122—127
179,500	Feb. 22	5	5	East Surrey 'B,' 5 p.c.	87—92
176,461	June 28	5	5	Do. 5 p.c. Deb. (Irred.)...	121—126
250,000	July 26	4	6	Gas Consolidation Ord. 'B' ...	19/—21/-
250,000	May 10	4	4	Do. 4 p.c. Red. Cum. Pref.	18/—20/-
19,107,811	Aug. 9	†1	3	Gas Light & Coke Ord. ...	19/—20/-a
2,600,000	"	†1½	3½	Do. 3½ p.c. max.	77—81
4,477,106	"	4	4	Do. 4 p.c. Con. Pref. ...	93—96
2,993,000	July 12	3½	3½	Do. 3½ p.c. Red. Pref. ...	95—98
8,602,497	May 31	3	3	Do. 3 p.c. Con. Deb. ...	84½—87½
3,642,770	"	5	5	Do. 5 p.c. Red. Deb. ...	107—110
3,500,000	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	106—109
700,000	March 8	3½	3½	Do. 3½ Red. Deb. ...	96—99
5,600,000	May 13 '40	4	8	Imperial Continental Cap. ...	91—94
43,820	July 26	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100
231,978	Aug. 23	5	5	M.S. Utility 'C' Cons.	95—100
918,657	"	4	4	4 p.c. Cons. Pref.	89—94
675,000	May 3	‡4	‡4	Montevideo, Ltd.	95—100
300,000	April 27	9	7	Oriental, Ltd.	110—115
368,537	June 15	3½	2½†	Plymouth & Stonehouse 5 p.c.	97—102
621,667	Aug. 16	7½	7½	Portsmouth & Gosport Cons.	120—125
2,381,363	May 17	4†	4†	Primitiva Holdings, Ltd. Ord.	11/6—13/6
233,900	June 15	3½	3½	Do. 6½ p.c. Red. Cum. Pref.	99—104
648,999	May 31	1/1½	1/1½	Severn Val. Gas Cor. Ld. Ord.	21/—22/-
597,972	March 8	4½	4½	Do. 4½ p.c. Cum. Pref. ...	20/—21/-
2,528,714	Aug. 23	7½	7½	South East'n Gas Cn. Ld. Ord.	20/6—21/6
1,000,000	"	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/9—20/9
1,068,869	"	4	4	Do 4 p.c. Irred. Cum. Pref.	19/—20/-
6,709,895	Aug. 16	†6	6	South Met. Ord.	90—93
1,135,812	"	†4	4	Do. 6 p.c. Irred. Pref. ...	126—131
850,000	"	—	†4	Do. 4 p.c. Irred. Pref. ...	90—95
1,895,445	June 28	3	3	Do. 3 p.c. Perp. Deb. ...	82—87
1,000,000	July 12	5	5	Do. 5 p.c. Red. Deb. ...	103—108
1,843,795	Aug. 3	4	4	South Suburban Ord. 5 p.c ...	97—102
812,825	"	5	5	Do. 5 p.c. Perp. Pref. ...	107—112
800,000	"	4	4	Do. 4 p.c. Perp. Pref. ...	88—93
250,000	"	3½	3½	Do. 3½ p.c. Red. Pref. ...	90—95
888,587	June 15	3	5	Do. 5 p.c. Perp. Deb. ...	122—127
750,541	Aug. 16	6	5	Southampton Ord.	92—97
350,000	" 15	5½	5½	Swansea 5½ p.c. Red. Pref. ...	95—100
1,076,495	Aug. 3	5	5	Tottenham & District Ord. ...	108—113
338,555	"	5	5	Do. 5 p.c. Pref.	106—111
453,380	June 7	4	4	Do. 4 p.c. Perp. Deb. ...	102—107
1,247,505	May 31	4	6	U. Kingdom Gas Cor. Ord. ...	20, 9—21/9
1,085,952	" 17	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	19/—21/-
772,709	"	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	19/—21/-
745,263	June 21	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	17/—19/-
1,200,000	March 15	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100
380,606	Aug. 16	6⅜	6⅜	Uxbridge, &c., 5 p.c.	118—123
1,371,138	" 3	6	5	Wandsworth Consolidated ...	107—112
2,525,768	"	4	4	Do. 4 p.c. Pref.	91—96
1,343,964	June 15	5	5	Do. 5 p.c. Deb.	122—127
383,745	"	4	4	Do. 4 p.c. Deb.	101—106
558,342	Aug. 9	5	5	Watford & St. Albans Ord. ...	110—115
300,000	June 7	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Aug. 26
351,685	June 15	5	5	Brighton, &c., 5 p.c. Perp. Deb.	122—127
415,250	"	4	4	Bristol Gas Co., 4 p.c. New Deb.	100—105
140,205	July 26	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	135—140
295,932	March 8	5	5	Cheltenham, 5 p.c. Cons .Ord....	97—102
42,500	June 15	4	4	Do. 4 p.c. Perp. Deb....	102—107
150,000	Aug. 23	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	89—94
130,000	June 28	4	4	Do. 4 p.c. Deb. ...	101—106
146,700	Feb. 22	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	110—115
53,220	" 9	6	6	Do. 6 p.c. Cum. Pref. ...	120—125
...	Aug. 19'40	6	4	Eastbourne, 'B' 3½ p.c.... ...	52—57
117,425	Feb. 5 '40	8	8	East Wight Cons. 5 p.c. ...	65—70
239,135	July 26	5	5	Gas Consolidation 'A' Ord. (£1)	18/—20/-
156,600	Aug. 16	5	5	Hampton C't, 5 p.c. Cons. Ord.	95—100
18,000	Dec. 29'41	3½	3½	Malta & Med'n., 7 p.c. 1st Pref.	30—40
10,845	June 30'41	3½	3½	Do. 7½ p.c. 2nd Pref.	30—40
50,000	Aug. 23	£5 4 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	90—95
70,380	June 21	5	5	Newport (Mon.), 5 p.c. Deb...	110—115
65,000	May 17	5	5	North Middlesex, 5 p.c. Pref....	105—110
70,000	March 15	5	5	Plymouth & Stone., 5 p.c. Deb.	112—117
76,501	June 21	4	4	Reading, 4 p.c. Perp. Deb. ...	97—102
74,777	March 31	4	4	Romford, 4 p.c. Debs. (Reg.) ...	95—100
21,000	June 15	5	5	Slough, 5 p.c. Perp. Deb. ...	120—125
211,740	" 28	5	5	Southampton, 5 p.c. Red. Deb.	103—108
363,575	July 1	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	99—102
202,019	Aug. 16	7½	7½	Tunbridge Wells, 4 p.c. Scale ...	122—127
135,257	June 15	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	121—126

PROVINCIAL EXCHANGES

					Quotations Aug. 23
804,948	March 1	5	5	Bath Cons.	102—105
122,577	Aug. 9	7	5	Blyth 5 p.c. Ord.	114—116
1,667,250	July 19	5	5	Bristol, 5 p.c. max.	114—116
120,420	June 15	4	4	Do. 1st 4 p.c. Deb.	100½—102½
415,250	"	4	4	Do. 2nd 4 p.c. Deb. ...	100½—102½
328,790	"	5	5	Do. 5 p.c. Deb.	116—120
157,150	Aug. 3	6½	5	Chester 5 p.c. Ord.	98—102
92,500	June 15	4	4	Do. 4 p.c. Pref.	78—80
36,430	"	3½	3½	Do. 3½ p.c. Deb.	77—81
41,890	"	4	4	Do. 4 p.c. Red. Deb. ...	97—99
542,270	Feb. 8	6	9	Derby Cons.	122—127
55,000	June 15	4	4	Do. 4 p.c. Deb.	97—102
10,000	Feb. 22	10	10	Great Grimsby 'A' Ord. ...	160—170
6,500	"	10	10	Do. 'B' Ord.	160—170
79,000	"	10	10	Do. 'C' Ord.	150—160
732,000	Aug. 23	4	4	Hartlepool G. & W. Cn. & New	86—88
2,167,410	" 16	5½	5	Liverpool 5 p.c. Ord.	106—107
306,083	Jan. 18	4	4	Do. 4 p.c. Deb.	100—102
20,000	Dec. 21	5	5	Long Eaton 5 p.c. Pref.	9—11
80,000	"	5	5	Do. 5 p.c. Deb.	100—105
2,430,267	Aug. 3	5½	5½	Newcastle and Gateshead Con.	23/3—23/9
682,856	"	4	4	Do. 4 p.c. Pref.	99—101
776,706	June 28	3½	3½	Do. 3½ p.c. Deb.	96½—97½
277,285	April 27	5	5	Do. 5 p.c. Deb. '43 ...	99—101
13,200	Sept. 16	8½	7	Pontyp'l Gas & W. 10 p.c. A'	11½—12½
13,600	"	6	5	Do. 7 p.c. 'B'	9½—10½
40,000	"	5	6	Do. 7 p.c. 'C'	9½—10½
106,280	Aug. 9	10	10	Preston 'A' 10 p.c	167—169
188,219	"	7	7	Do. 'B' 7 p.c.	124—129
1,806,339	" 22	6½	6½	Sheffield Cons.	138—142
95,000	Jan. 4	4	4	Do. 4 p.c. Deb.	98—100
332,351	Feb. 22	6	6	Sunderland 6 p.c. max. ...	114—116
192,150	Aug. 9	5	5	Weston-super-Mare Cons. ...	105—107
64,338	July 5	4	4	Do. 4 p.c. Deb.	99—101
33,340	"	7½	7½	Do. 7½ p.c. Deb.	142—147

a—The quotation is per £1 of Stock. * Ex. div. † For year. ‡ Paid free of income-tax.